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09/594,905	06/15/2000	Emilio Rodriguez Cabeo	A33169 PCT USA	9388

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EXAMINER	
PADGETT, MARIANNE L	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/594,905	Applicant(s) ~~Rodriguez~~ Cabeo et al
	Examiner M.L. Padgett	Group Art Unit 1762

—*The MAILING DATE of this communication appears on the cover sheet beneath the correspondence address*—

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, such period shall, by default, expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

☒ Responsive to communication(s) filed on 9/22/00, 10/13/00 & 12/19/00.

☐ This action is FINAL.

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

☒ Claim(s) 1-39 is/are pending in the application.

Of the above claim(s) ______ is/are withdrawn from consideration.

☐ Claim(s) ______ is/are allowed.

☒ Claim(s) 1-39 is/are rejected.

☐ Claim(s) ______ is/are objected to.

☐ Claim(s) ______ are subject to restriction or election requirement

Application Papers

☐ The proposed drawing correction, filed on ______ is ☐ approved ☐ disapproved.

☐ The drawing(s) filed on ______ is/are objected to by the Examiner

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119 (a)-(d)

☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119 (a)-(d).

☐ All ☐ Some* ☐ None of the:

☒ Certified copies of the priority documents have been received. 197 55 595.0 German

☐ Certified copies of the priority documents have been received in Application No. ______.

☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a))

*Certified copies not received: ______.

Attachment(s)

☒ Information Disclosure Statement(s), PTO-1449, Paper No(s). 3

☒ Notice of Reference(s) Cited, PTO-892

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Interview Summary, PTO-413

☐ Notice of Informal Patent Application, PTO-152

☐ Other ______

Office Action Summary

1. Claims 1-29 & 37-38 are objected to or rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

All the independent method claims 1-3 are vague and indefinite, because their claimed steps are not commensurate in scope with their preambles, which require producing a boride layer. There is no layer of any sort produced in the body of the claim, nor is there necessarily any surface present to produce one on. Only claim 4 and its dependents (when they depend from it only) and dependant claims 7, 9 and 10 correct this problem.

Use of relative terms that lack clear metes and bounds in the claim, in a definitive definition in the body of the specification, or in cited relevant prior art, are vague and indefinite. In claims 4, 7, 9 and 10 see "low", "thin" and "dense". Note that use of "higher" would be ok, if the temperature if referred to in comparison was not indefinite. Also in claim 37, "purification" can be considered relative, as what actions or effects might be sufficient to consider a substance or mixture purified, will vary depending on need or situation, etc.

In claim 1, line 6, "the amount..." is objected to as lacking proper antecedent basis, as is the same term in claim 11, when dependent from claim 2, but not 5. In claim 15, line 1 "a gas mixture" is objected to for its unclear antecedence relationship to the identical term introduced in all 4 independent method claims. Clear differentiation or an article indicating antecedent basis should be employed. Claims 16-21 have very confused antecedence as some of the multiple claims that these claims depend from previously used newly introduced terms, and some did not. For example, "a pulse period" is introduced by claim 3, last time, but not the other claims, although claim 2 has "voltage pulse duration" whose relationship thereto is unclear, as they could be synomous or the period could also include the "subsequent pulse pause duration."

In claim 1, the intended meaning of lines 8-12 is unclear. The terms "minimum and/or maximum value" have no inherent meaning in and of themselves, or with respect to the excited gas product or to some unspecified "relation" of those gas products. This unclear limitation cannot be properly examined on its merits with respect to the prior art. Claim 14 makes very little sense with respect to claim limitation for reason analogous to claim 1.

In claim 11, when or relative to what is the "determining ..." carried out? Note that anyone noticing that the glow discharge has not yet been generated, has made a relative determination, that there are essentially no excited species in the reactor.

Claim 27, does not contain any positive limitation, since claims 26 include zero % noble gas, thus no noble gas or Ar need be employed.

In claims 22 and 23, while the meaning of the units of Pa, mPa or KPa would be understood, the examiner is unfamiliar with the units "hPa". What does the "h" stand for? Hepta (7 decimal places bigger or smaller), or is it a typographical error? It is noted that the same units are disclosed in the specification on page 7, hence applicant should be sure to provide clear support for any amendment that changes the unit symbol used.

Note in claim 4, while not formally incorrect, since there are no halogens necessarily present in the gas mixture (or the surface), there is potential no possibility of forming halogenides in the first place, hence nothing the necessarily be prevented.

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 30-31, 37 and 39 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Hunger et al (Canadian).

4. Claims 1-3, 5-6, 8, 11, 13-29, 32-36 & 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hunger et al (Canadian).

The Canadian patent to Hunger et al teaches depositing boride layers via a pulsed plasma, having a gas mixture of a boron trihalide, such as BF_3 at 0.1 to 30 vol. %, mixed with H_2 (20-90% vol.) and optionally containing argon. Useful pressures are taught to be 1-10 mbar (i.e. 0.1-1 KPa). The examples teach use of D.C. glow discharge plasma with a constant pulse frequency of 4 KHz, therefore assuming that one cycle = one pulse period, the corresponding pulse period is 250 μsec. See the abstract, page 3 and examples 1-2 (page 5 and 6).

A useful pulsed plasma apparatus is also described on page 5, which has a heatable reaction chamber; a pump system for evacuating the chamber and setting pressures, a gas supply unit for mixing and metering gas mixtures; a pulsed plasma generator (which with the examples 1-2 disclose D.C., so inherently has pulsed D.C. voltage) which is noted to have means for wide range of pulse frequencies or pulse widths; and systems for neutralizing and disposing of the gas (equivalent to purification), and <u>for controlling</u> and maintaining the operating parameters. Note while Hunger et al use gases as claimed, it is not necessary for an apparatus to do so, in order to read on the claimed apparatus structure, since the gas used in the apparatus are not part of it.

As noted above, the "determining the amount... excited...product", can be done at any time, in anyway, with any degree of precision, and it would have been obvious for one of ordinary skill to note whether the plasma is or is not present, hence reaction products for reactions as discussed on page 4, have or have not been formed. Furthermore, Hunger et al teach monitoring and controlling their reaction parameters to control the course of the reaction, hence would have obviously selected parameters which produce suitable reactive species in the plasma, because such would have been required to produce an efficient deposition process. Applicant's unclear phrasing (claimed 14) cannot be more precisely treated at this time.

While the pulse period of Hunger et al's example is 250 μs, not significantly higher than the claimed 230 μsec in applicant's claimed range of less than that value. Considering that Hunger et al teach a wide range of pulse frequencies and widths, it would have been obvious to one of ordinary skill in the art to use the exemplary frequency as a guide line, and perform routine experimentation to optimize according to reactor, gases employed, desired end results, etc., hence the values would have been expected to be overlapping with claimed ranges. Note as Hunger uses pulsed D.C., there are inherently pause durations as well as pulse durations, and the taught wide range of pulse widths, would have been expected to include those around 1:1 or insignificantly different there from such as the claimed 1.1 to 1. Furthermore, as the plasma can be used to heat the substrate (Ex. 2), and the pulse with controls the power density to cause the heating, it would have been obvious to one of ordinary skill in the art to determine such required pulse width, hence, also pauses, via routine experimentation.

The meaning applicant's pressure units "hPa" is unknown, however if it is a typographical error for kPa, Hunger et al's values overlap with applicant's claimed range, and one of ordinary skill in the art might conclude that such was probably intended.

Hunger et al do not discuss what voltage ranges are useful in the process, however it would have been obvious for one of original skill in the art to determining such, since voltage is a necessary component of the process. Hunger et al obviously expects one of ordinary skill in the art to be able to readily determine appropriate voltages.

While Hunger et al does not detail the use of a pressure gauge, a computer, a gas spraying device for gas distribution, or a cooled gas inlet, they do teach general monitoring and control. One of ordinary skill in the art would find such devices obvious components to use in Hunger et al's apparatus, because they are conventional means of achieving the taught monitoring and control. Note that temperature control of inlets, i.e., cooling to prevent premature reaction or heating to prevent condensation, are old and well-known techniques. While Hunger et al do not specifically specify that their vacuum pump is connected to the gas neutralizing and disposing system, one of ordinary skill in the art would have expected them to be so connected, since gas is received via the pump and it would be both safe and most efficient to neutralize/purify the used gas at the soonest moment.

5. Claims 2, 5, 11, 13, 14 and16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hunger et al as applied to claims 1-3, 5-6, 8, 11 & 13-39 above, and further in view of Oppel et al.

The Canadian patent to Oppel et al is cumulative to the above Hunger et al rejection, as its discussion of vapor and lower threshold values for parameters used in a pulsed plasma process, may have some relationship to applicants' intended meaning for "minimum and/or maximum value", although that cannot be clearly determined. Also, Oppel et al illustrate a means for using pulse-pause ratios in regulating temperature, which is related to Hunger et al's Ex. 2 process. It would have been obvious to one of ordinary skill in the art to apply the teachings of Oppel et al concerning temperature control, and pulse-pause ratio in the plasma to

Hunger et al, in order to achieve the taught heating via glow discharge plasma in a controlled manner, as Hunger et al teaches monitoring and control generally, with Oppel et al providing a specific applicable means.

6. Claims 3, 15, 18-20, 24, 26, 27, 29-32 and 39 are rejected under 35 U.S.C. 102(b) as being anticipated by Hou.

Hou teaches pulsed RF plasma, where a variable D.C. power supply is used to supply voltage (0-600 volts) to create the pulses. The frequencies, i.e. pulse repetition rate maybe from 0.1 to 20 kHz, which produces pulse periods in the claimed range of less than 230 μsec (col. 5, lines 1-15 and 46-75, the gases used are a mixture of hydrogen and a boron compound, such as boron trihalides (BF_3, etc...), alkylborates ($B(OR)_3$), diborane (B_2H_6), etc. (col. 3, line 50-col. 4, line 20), where relative quantities of boron compound to hydrogen are determined from the molar ratio of B to H of about 1:2 to about 1:5, hence BF_3 to H_2 volume ratios, assuming ideal gas behavior, would be 1 BF_3:2 ($1/2H_2$)=1:1 to 1 BF_3:5 ($1/2H_2$)=1:2.5, or 50% BF_3 to about 28% BF_3.

Hou teaches variable on and off times/durations for the pulses, noting that heat generation can be control through variation of the pulse repetition rates, the pulse width or duration, or both (col. 6, lines 28-57). A thermocouple is used to measure temperature shown on meter 25, so that the expectation, hence temperature of the process can be controlled via the pulse characteristics (col. 6, lines 58-73). On col. 7, lines 1-10 Hou gives repetition rates of about 0.5-100 kHz (i.e., pulses of 2000 μsec to 100 μsec) and pulse widths of 0.1 to 1000 μsec, therefore the pause durations would correspond to the difference so pulse duration to pause is 1:1 or less.

Note example 1 indicates that the input rate of H_2 and B-gas individually controlled, hence means to do so are inherently suggested.

7. Claims 1-2, 4-11, 13-16, 18-21, 24-29 and 33-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hou.

As noted above, Hou's teachings suggest a ratio of voltage pulse duration to subsequent pause of about 50:50 or 1:1, which while not the same as greater than 1.1 : 1, is insignificantly different, because one of ordinary skill in the art would find it obvious to include numbers around the 1:1 ratio (i.e., the 1.1:1) in the useable ratios calculated from Hou's disclosure, because they are within the bounds of that the significant figures would include with the "about" phasing of taught parameters.

Claim 1 and dependents are included for reasons/uncertainties as discussed in section 1 and 4 for claim 1. Obviousness of using pressure gauges and computers are analogous to those of section 4 also.

Hou does not teach a two stage process, where a lower then a higher temperature is used to deposit their boride layer, however in col. 5, lines 28-42, it is noted that the "coating zone may assume a slightly more elevated temperature than the gaseous atmosphere, because of recombinate reaction occurring at the surface...". Therefore, one of ordinary skill in the art would recognize that, since the substrate proceeds continually through the reaction chamber, its temperature, and that of the gas immediately surrounding it would have been higher at the end of the reaction chamber, than at the beginning. As the temperature of the chamber is controlled, this expected variation during the transverse of the length of the chamber would have been expected to be maintained. Note that since there is no claimed specific degree of temperature variation, non-relative or necessary effects claimed, this is sufficient to read on the claimed language.

8. The U.S. patent to Strämke, given as equivalent to the German reference to the same inventor was found to contain no disclosure on boride deposition or use of B-containing

gases, and the pulse pause ratio discussed in the summary of 1:10 to 1:500 had values with opposite trends than those claimed.

9. Claims 30-31 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Schnatbaum et al (given as the equivalent for German references to ALD Vac. Tech.).

See Figures 1-3; col. 1, lines 6-11; Summary; col. 2, line 45-col. 3, line 35+.

10. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hunger et al (Canada) or Hou as applied to claims 2 or 5 in sections 4, 5 or 7 above, and further in view of Walthers or Kohler et al.

While the above references discuss monitoring or control of various aspects of their plasmas and process, there are no teachings on spectroscopically determining amounts of B-containing excited species in their plasmas, however it is old and well known to monitor plasma species by such means as illustrated in Kohler et al (Figure 1; col. 5, line 51- col. 6, line 15 for pulsed D.C. power supply/voltage) or Walther (abstract; col. 1, lines 24-34 and col. 2, lines 30-59^{+}), both of which show spectroscopic analysis of plasma species in pulsed plasma processes, thus it would have been obvious to apply such old and well known techniques in Hunger et al or Hou, in order to provide effective monitoring means, because it is known that such monitoring enables more accurate control, and for optical emission spectroscopy particularly because such means produces no harmful interactions with the plasma.

11. Other art of interest include Denholm et al, Shao et al and Sheng, who discuss pulsed plasmas, D.C. voltages, etc.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to M. L. Padgett whose telephone number is (703) 308-2336. The examiner can normally be reached on Monday-Friday from about 8 a.m. to 4:30 p.m..

The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-5408 or 872-9310 (official); or 308-6078 (unofficial).

M.L. Padgett/dh
April 30, 2002

April 30, 2002

MARIANNE PADGETT
PRIMARY EXAMINER
GROUP 1700